using the needle was, it must be confessed, rude enough. The passage in the treatise 'De Utensilibus' contains one particular which is very obscure, as Neckam informs us that when the needle ceased moving it pointed towards the east (*donec cuspis acus respiciat orientem*); and as all the manuscripts agree in this reading, and it is glossed by *est*, this must be the intention of the writer. I know no way of explaining this, unless it be by the supposition that as in the twelfth century, the East was the grand object of most voyages from this part of the world, an attempt had been made to improve the magnetic needle, by adding to it a limb at right angles, which should point to the east when the needle itself pointed to the north, and that this was what Neckam called the *cuspis acus*. Between this and the date—whatever it may be—of the poem, also quoted in my note on the passage of Neckam, which contains the first allusion to the mariner's compass in the thirteenth century, an attempt had been made to facilitate its use.[1] This was done by thrusting the needle through some substance which would not sink, and placing it upon the surface of water. Guiot de Provins, the author of the poem alluded to, calls this substance a *festu*, a stick or straw (the Latin *festuca*). The mariners, he tells us, have a contrivance depending on the magnet, which cannot fail. The magnet, he adds, is an ugly brownish stone, to which iron is attracted. 'After they have caused a needle to touch it, and placed it in a stick, they put it in the water, without anything more, and the stick keeps it on the surface. Then it turns its point towards the star with such certainty that no man will ever have any doubt of it, nor will it ever for anything go false. When the sea is dark and hazy, that they can neither see star nor moon, they place a light by the needle, and then they have no fear of going wrong; towards the star goes the point, whereby the mariners have the knowledge to keep the right way. It is an art which cannot fail.' According to another poet, the substance through which the needle was usually thrust was cork. He tells us that 'the mariners who went to Friesland, or to Greece, or Acre, or Venice' were guided by the polar star; but when at night, or in obscure weather, it was invisible, they discovered its position by the following contrivance:—'They thrust a needle of iron through a piece of cork, so that it is almost buried in it, and then touch it with the loadstone; then they place it in a vessel full of water, so that no one pushes it out until the water is calm, for in whatever direction the point aims, there without doubt is the polar star.' The MS. in which this latter poem was found is undoubtedly of the fourteenth century; but the poem itself is evidently of somewhat older date of the beginning of that century, or not improbably of the century preceding. It is possible therefore that this rudely constructed mariner's compass may have continued unimproved until the fourteenth century."[2] (*Introduction*, pp. 16-18.)

The following is the text of Neckam with the interlinear gloss:—

ille une pere faut naute
"Qui ergo vult habere navem, albestum habeat, ne desit ei
fu aguyl mis
beneficium ignis.[1] Habeat etiam acum[2] jaculo suppositam,
turne e enurun aguyl poynt agardet
rotabitur enim et circumvolvetur acus donec cuspis acus respiciat
est tali modo i. ubi mariners
orientem, sic que comprehendunt quo tendere debeant naute cum cinossura" [the cynosure, κυνόσουρα, or constellation popularly
atapist de l'eyr tempeste cinossura
called Charles's wain] "latet in aeris turbacione, quamvis ad
achecement circle petit
occasum nunquam tendat propter circuli brevitatem." ("De Utensilibus," p. 114.)

Mr. Wright adds: "The earliest account of the mariner's compass, before known, was contained in the following lines of a satirical poem, entitled the 'Bible Guiot de Provins,' composed in the thirteenth century." (Barbazan, "Fabliaux," tom. ii. p. 328.)

"Un art font qui mentir ne puet
Par la vertu de la maniete,
Une pierre laide et brunete,
Où li fers volontiers se joint,
Ont; si esgardent li droit point,
Puis c'une aguile i ont touchié,
Et en un festu l'ont couchié,
En l'eve le metent sanz plus.
Et li festuz la tient desus;
Puis se torne la pointe toute
Contre l'estoile, si sanz doute,
Que jà nus hom n'en doutera,
Ne jà por rien ne fausera.
Qant la mers est obscure et brune,
C'on ne voit estoile ne lune,
Dont font à l'aguille alumer,
Puis n'ont-il garde d'esgarer;
Contre l'estoile va la pointe,
Por ce sont li marinier cointe
De la droite voie tenir.
C'est uns ars qui ne puet failler."

The language of the last extract fully bears out Mr. Wright's estimate of it as not earlier than the thirteenth century.

WM. CHAPPELL

The Dry River-beds of the Riviera

MR. H. T. WHARTON'S letter (NATURE, vol. xiii., p. 448) does not seem fully to explain the difficulty expressed by Mr. R. E. Bartlett (NATURE, vol. xiii., p. 406), a difficulty which is often felt by many of the visitors to the Riviera. Mr. Wharton is quite correct with regard to the Paglione. This stream has, I believe, within the last few years been often in high flood, and has been more than once within a foot or two of the top of the arches of the bridge which Mr. Bartlett seems to think is unnecessarily large. The Paglione, where it passes through Nice, is not, however, a fair representative of the river-beds of the Riviera. When the river-walls were built, which now retain the Paglione, the river-bed was, in all probability, made much narrower than it previously was, on account of the value of the land for building purposes, and only so much of the river-bed retained as was necessary to carry away the water, so that the Paglione now completely fills its channel when in flood. This is far from

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[1] In this interval we meet with another slight but very curious allusion to the use of the magnetic needle for the purposes of navigation. Jacques de Vitri, one of the historians of the Crusades, who wrote about the year 1218, says ("Hist. Hieros," cap. 89):—"Acus ferrea, postquam adamantem contigerit, ad stellam septentrionalem, quæ velut axis firmamenti, aliis vergentibus non movetur, semper convertitur; unde valde necessarius est navigantibus in mari."

[2] This very curious poem, a sort of song, is preserved in a manuscript formerly in the collection of M. Barrois, of Paris, and now in that of Lord Ashburnham. It was first pointed out by M. Fr Michel, who printed the portion relating to the mariner's compass in the preface to his "Lais Inedits" (Paris, 1836). As this is now a rare book, I have thought it desirable to give here the whole passage, as a complement to the extracts given in the note on p. 114 of the present volume. It is as follows:—

"La tresmontaine est de tel guise
Qu'ele est el firmament asisse
Où ele luist et reflambie:
Li maronier qui vont en Frise,
En Gresse, en Acre, ou en Venisse,
Sevent par li toute la voie;
Pour nule riens ne se desvoie,
Tout jours se tient en une moie,
Tant est de li grans li servisse,
Se la mers est enflée ou koie,
Jà ne sera c'on ne le voie,
Ne pour galerne ne pour bise.

Pour bise, ne pour autre afaire
Ne laist sen dout servise à faire
La tresmontaigne clere et pure;
Les maroniers par son esclaire
Jete souvent hors de contraire,
Et de chemin les asséure.
Et quant la nuis est trop oscure,
S'est ele encor de tel nature,
C'à l'aimant fait le fer traire,
Si que par forche et par droiture,
Et par ruille qui tous jours dure,
Sevent le liu de son repaire,
Son repaire sevent à route,
Quant li tans n'a de clarté goute,
Tout chil qui font cest maistrise,
Qui une aguille de fer boute
Si qu'ele pert presque toute
En .i. poi de liége, et l'atise
A la pierre d'aimant bise;
En .i. vaissel plain d'yave est mise,
Si que nus hors ne la deboute,
Si tost com l'iave s'aserise;
Car dons quel part la pointe vise,
La tresmontaigne est là sans doute."

[1] It was believed that the asbestus, when once lighted, could never be extinguished, and hence Neckam recommends it to be carried on shipboard, that the sailors may never be without fire.

[2] This rather obscure description of the mariner's compass, belonging certainly to the twelfth century, is the earliest allusion to the use of that important instrument in the middle ages. Alexander Neckam has, however, given a rather fuller description of it in another of his books, the treatise "De Naturis Rerum," lib. 2, c 89 (MS. Reg. 12 G. xi., fol. 53 v°): "Nautæ etiam mare legentes, cum beneficium claritatis solis in tempore nubilo non sentiunt, aut etiam cum caligine nocturnarum tenebrarum mundus obvolvitur, et ignorant in quem mundi cardinem prora tendat, acum super magnetem ponunt, quæ circulariter circumvolvitur usque dum, ejus motu cessante, cuspis ipsius septentrionalem respiciat." [Here the error about pointing to the east is corrected.]

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being the case with most of the Riviera torrents. For instance, the channels of the streams near Menton, Vintimiglia, and elsewhere, are far out of all proportion to the work they have to do. Take the case of the principal stream at Menton. At a distance of less than two miles from the sea where its bed is formed of rock, it has only a breadth of a few yards, and has no high flood-marks indicating that there is ever a great depth of water. If the stream is followed downwards from this point for less than a mile, the bed is found to open out to a breadth of from sixty to seventy yards. Between these points there are no tributary streams adding their waters to account for this increase. These large river-beds are caused by the nature of the country which these rivers drain. The country is very mountainous, the hill slopes are rocky and steep, large areas have no covering of soil, and what soil there is does not retain the water well. The result of this is, that when rain falls the water rapidly finds its way to the streams, and the same amount of rainfall is discharged by these streams in a few hours as is discharged in weeks by an English river draining the same area. This accounts for these torrents rising so "high" and falling so "low." It also accounts for them "rising" and "falling" rapidly.

But further, the great and unnecessary breadth of these torrent-beds where they approach the sea seems to be produced somewhat in the following way:—The valleys through which these streams flow descend rapidly from the mountains, but as they approach the sea their slope becomes much slower; the result of this is, that the gravel brought down by the river from its higher and more rapid reaches, is here deposited, on account of the water losing its velocity, and the bottom of the valley becomes filled with a bed of gravel, through which the stream winds sometimes in one part, sometimes in another. A very small cause being sufficient to make the stream "cut" into the gravel and alter the position of its bed, and cause it to flow in different parts of the channel at different times, but it almost never covers at one time the whole breadth of it.

That the bed of the principal stream at Menton is unnecessarily large, is evident from the fact that now, on account of the increased value of land, they are building a retaining-wall near the centre of the stream, and filling up about one-half of the river-bed for the purpose of cultivation.

Rivers similar to those of the Riviera are common to all mountainous countries, Britain not excepted. There is at least one salmon river in Scotland, which during the dry season may be walked across without wetting the soles of one's boots, all the water finding a passage among the gravel. Yet in Autumn, when it has fallen to "fishing condition," it is a stream of about thirty yards broad, and an average depth of about two feet on the fords. This river is also subject to great floods, which "come down" rapidly, and "fall" rapidly. It also has gravel deposits similar to those of the Riviera torrents, but in this case they are covered with soil and cultivated, and it is with the greatest difficulty and at great expense that the river is prevented from widening its channel to the proportions of those of the Riviera torrents. JOHN AITKEN

Bellagio, Lago di Como, Italy

Method of Distributing Astronomical Predictions

I BEG leave to observe that the very useful method of distributing astronomical predictions over a given geographical area alluded to in NATURE, vol. xiii., page 71, and ascribed there to Mr. W. S. B. Woolhouse, was already proposed by my father, J. J. von Littrow, in his treatise, "Darstellung der Sonnenfinsterniss vom 7 September, 1820," Pest, 1820, as well as in the *Berliner Astronomisches Jahrbuch*, for 1821, page 116, and 1822, page 145; subsequently in his "Theoretische und practische Astronomie," Wien, 1821, part ii., page 280; and last in his "Vorlesungen über Astronomie," Wien, 1830, part i., page 306. Since then numerous applications have been made thereof. My father expressed the well-founded desire that in the astronomical almanacs formulæ might be given similar to that communicated in NATURE. CHARLES DE LITTROW

Vienna, June 1

Acoustical Phenomena

IN connection with Doppler's disputed theory of the colours of stars, the illustration usually employed to assist the mind in forming a conception of the hypothesis is that of the whistle of a passing locomotive. The note of the whistle, which, as it approaches, seems shriller than its normal pitch, owing to the greater number of vibrations impinging upon the ear in the unit of time, falls half a tone more or less, as the engine passes and recedes. To unmusical ears the difference in the note is a very doubtful fact, only to be taken on hearsay. There is, however, another fact of kindred nature to which attention has not, I believe, been generally drawn. Almost all railway engines, and especially those drawing heavy goods' trains, have, owing to the manner in which the valve-gearing is set, the property of producing the well-known *staccato* puffs of steam, audible to the ear as well as evident to the eye. Anyone who will listen to these puffs as the train dashes by will be aware of a very distinct and well-marked change in their apparent rapidity of succession at the moment of passing. So distinct is the change that almost invariably the first effect on the mind is the illusory suggestion that the train has suddenly slackened speed. This change is heard best at night, and when the passing train is a heavy one, not running too quickly. It cannot fail to be appreciated even by non-musical ears. As an illustration of a scientific principle it is, perhaps of the greater value, as a popular error seems to exist on the subject of the change of the note of the whistle, to the effect that the lowering in pitch is very gradual during the approach and recession of the engine, an opinion obviously incorrect if the observer be close to the train.

London, June 7 S. P. THOMPSON

Giant Tortoises

IN NATURE, vol. xiv. p. 60, it is stated that Commander Cookson, of H.M.S. *Petrel*, is bringing home two live specimens of the giant tortoise of the Galapagos; that *if* their food lasts, and *if* they are not killed by the cold off Cape Horn, they will be the first specimens seen alive in this country.

Even should the tortoises survive the two *ifs* above given, they will not be the first living specimens seen in this country.

A large specimen brought from the Galapagos Islands by one of the ships of the late S. R. Graves, M.P., lived in good health for nearly ten years in our Dublin Zoological Gardens.

This animal was examined, after death, by Dr. Günther, who states that it is not identical with the Indian species, as supposed by former naturalists. SAMUEL HAUGHTON,
Secretary Royal Zoological Gardens,
Dublin

Trinity College, Dublin, June 2

Photography of the Loan Collection Apparatus

THE Loan Collection of Scientific Apparatus at South Kensington contains many apparatus, as for instance the first air-pump of Otto von Guericke, the first boiler of Papin, the first locomotive, &c., which for the friends of science will ever be of great historical interest. Therefore I cannot refrain from expressing the wish that opportunity should be given to take photographs of convenient size of some of the most interesting apparatus. I believe many visitors will feel with me greatly gratified if such a more enduring remembrance could be taken home of an exhibition that perhaps for ever will remain unequalled.

The Hague, June 12 L. B.

ABSTRACT REPORT TO "NATURE" ON EXPERIMENTATION ON ANIMALS FOR THE ADVANCE OF PRACTICAL MEDICINE

THE courteous request of the editor of NATURE that I should contribute to his pages an abstract of my experience of the value of experimentation on animals and on the most useful applications of that method of research to the alleviation, directly or indirectly, of animal suffering in all the higher classes of animals is responded to in the subjoined notes.

I have already expressed my views on this subject on two occasions at large public meetings of the Royal Society for the Prevention of Cruelty to Animals, and in 1862 I made a report on the same subject to the indefatigable secretary of that society, Mr. Colam, which report he has recently published, and which on the points it refers to is in harmony with the conclusions of the late Royal Commission. I have not, however, entered into the discussion that for some months past has been in

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